

NORTH AMERICAN PARASITIC COPEPODS. DESCRIPTIONS OF NEW GENERA AND SPECIES.

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This eleventh paper^a in the series dealing with the North American Parasitic Copepods includes four new species, two of which are made the types of new genera. Two of the species were sent to the author by Dr. Barton W. Evermann of the U. S. Bureau of Fisheries, one was collected by Dr. Edwin Linton at the Tortugas, Florida, and the fourth was found in the Museum of the Johns Hopkins University. Sincere thanks are hereby returned to each of the senders, not merely for these favors but also for many others similarly conferred.

MIDIAS,^b new genus.

General form intermediate between that of *Caligus* and *Euryphorus*. First three thorax segments united with the head to form the carapace; frontal plates poorly defined but furnished with lunules. Fourth or free thoracic segment short and wide, with a pair of very rudimentary dorsal plates in the female.

Genital segment greatly enlarged and carrying a pair of rudimentary legs at the posterior corners in both sexes. Abdomen long, distinctly

^a The ten preceding papers are: 1. The Argulidæ, Proc. U. S. Nat. Mus., vol. 25, pp. 635-742, pls. 8-27. 2. Descriptions of Argulidæ, idem, vol. 27, pp. 627-655, 38 text figures. 3. The Caliginæ, idem, vol. 28, pp. 479-672, pls. 5-29. 4. The Trebinæ and Euryphorinæ, idem, vol. 31, pp. 669-720, pls. 15-20. 5. Additional Notes on the Argulidæ, idem, vol. 32, pp. 411-424, pls. 29-32. 6. The Pandarinæ and Cecropinæ, idem, vol. 33, pp. 323-490, pls. 17-43. 7. New Species of Caliginæ, idem, vol. 33, pp. 593-627, pls. 49-56. 8. Parasitic Copepods from the Pacific Coast, idem, vol. 35, pp. 431-481, pls. 66-83. 9. Development of *Achtheres ambloplitis* Kellicott, idem, vol. 39, pp. 189-226, pls. 29-36. 10. The Ergasilidæ, idem, vol. 39, pp. 263-400, pls. 41-60.

^b *Midias*, a disreputable Athenian.

two-jointed in the female, the basal joint with large lateral lobes; indistinctly jointed and without lobes in the male. Maxillary hooks and furca present; first three pairs of legs biramose; endopod of first pair rudimentary; both rami of third pair distinctly three-jointed. Egg-cases like those of the *Caliginæ*.

Type-species.—*M. lobodes*, new species.

MIDIAS LOBODES,^a new species.

Female.—General body form elongate and strongly flattened; carapace elliptical, the margin very evenly rounded, almost as wide as long and two-fifths of the entire length. Frontal plates not well differentiated, with a shallow median sinus; lunules small and widely separated, semicircular and projecting but little; posterior sinuses oval and shallow, lateral lobes curved inward at the tip; median lobe a little more than one-third the entire width and not reaching to the ends of the lateral lobes; thoracic area very small, transversely elliptical, one-half wider than long, and covering only the posterior third of the central portion of the carapace.

Free segment half the width of the genital segment, considerably enlarged through the bases of the fourth legs, and bearing a pair of rudimentary dorsal plates, which are slightly elevated and distinctly visible in the living female but flattened down and are easily overlooked in preserved specimens.

Genital segment the shape of an inverted U, squarely truncated posteriorly and two-thirds the size of the carapace, with a pair of legs plainly discernible at the posterior corners.

Abdomen nearly as long as the genital segment and two-jointed, with a large semielliptical lobe on either margin of the basal joint. These lobes are as long as the segment to which they are attached and extend outward to the level of the lateral margin of the genital segment. Posteriorly the abdomen is produced into a long cylindrical lobe on either side of the anal laminae. The latter are situated on the squarely truncated posterior margin of the abdomen, are about the same size as the posterior lobes, and are each armed with four terminal spines.

The egg-cases are twice the width of the anal laminae and a little longer than the entire body; the eggs are small and numerous, about 100 in each case.

Maxillary hooks of medium size, with a basal portion five times the width of the nearly straight terminal portion.

Mouth-tube short and semicircular in outline; first maxillae stout, not quite reaching the tip of the mouth-tube, and furnished with an accessory tooth or spine on the inner margin near the center. Ter-

^a *Lobodes*, λοβώδης, (λοβός + ἔδος), like a pea-pod, lobed, alluding to the large lobes on the sides of the basal joint of the abdomen in the female.

minal claw on the maxillipeds slender, bent into a half circle two-thirds the length of the basal joint, and carrying a tiny spine on its ventral surface one-third the distance from the base.

Furca short and stout, rami divergent and strongly curved. First legs slender, the basal joint with a rudimentary two-jointed endopod on its posterior margin; the three terminal claws with compound tips, made up of several points or teeth, and with a row of saw-teeth along each lateral margin.

Spines on the exopods of the second legs large and finely toothed along both margins. Spine at the base of the exopod of the third leg also large and bifurcated, the ventral branch shorter than the dorsal. Both rami of these third legs distinctly three-jointed.

Basal joint of the fourth legs enlarged into a broad lamina, three-fourths as wide as long; the three terminal joints the same length as the basal and armed with simple spines, all about the same length.

Total length 10 to 14 mm. Carapace 4.1 mm. long, 4 mm. wide. Free segment 0.8 mm. long. Genital segment 2.75 mm. long, 2.75 mm. wide. Abdomen 2.5 mm. long. Egg-tubes 12 mm. long.

Male.—Posterior body shorter and relatively smaller than in the female; carapace elliptical and as large as that of the female, with the same general proportions. The body behind the carapace, however, is only half as long as in the female, and relatively narrower, thus making the carapace more than half the entire length.

Free segment two-thirds the width of the genital segment and widened through the bases of the fourth legs.

Genital segment two-fifths the width of the carapace, nearly circular in outline, but broken at the posterior corners by the attachment of the fifth legs; on the ventral surface there is also a sixth pair of legs, inside the fifth pair and a little posterior to them.

Abdomen one-jointed and lacking the lateral lobes found in the female, somewhat shorter than the genital segment and only half as wide.

Maxillary hooks not much enlarged; first maxillæ without the accessory tooth on the inner margin; fourth legs with a much smaller basal joint, otherwise like the female.

Total length 7.25 mm. Carapace 4 mm. long, 3.9 mm. wide. Genital segment 1.5 mm. long and the same width. Abdomen 1.1 mm. long, 0.8 mm. wide.

Color of young specimens a rich cream yellow, becoming orange brown with maturity, the color being deepest over the convolutions of the oviducts and vasa deferentia in the genital segment.

Ten specimens of this species, including two males, were obtained from the outside surface of the head of a great barracuda, (*Sphyraena barracuda*), by Dr. Edwin Linton at the Tortugas, Florida, and are numbered 39613, U.S.N.M.

The present genus forms another connecting link between the Caliginæ and the Euryphorinæ. The presence of lunules marks its close affinity with *Caligus*, and the preserved material first obtained was referred to that genus. During the past summer, however, there has been an opportunity to study an abundance of living material, and a more careful examination reveals so many characteristics of the Euryphorinæ that it must be placed in the latter subfamily. These include among general characters the large size of the copepod, fully twice that of most species of *Caligus*, the possession of rudimentary dorsal plates on the fourth (free) segment, a strongly inflated genital segment, and an abdomen with lateral lobes on the basal joint and posterior lobes on the terminal joint.

In addition, the first legs have a rudimentary endopod which is two-jointed, both rami of the third legs are distinctly three-jointed, and the fourth legs have an enlarged basal joint, and three small terminal joints arranged like those in *Gloiopotes* and not at all like those in *Caligus*.

These, with minor differences in the anatomy of the other appendages, will not allow the species to remain among the Caliginæ, but it must be placed with other intermediate forms in the Euryphorinæ.

PARALEBION,^a new genus.

General form similar to that of *Alebion*. First three thoracic segments united with the head; frontal plates poorly defined and without lunules. Free thoracic (fourth) segment narrow and long, with barely the rudiments of a pair of dorsal plates in both sexes.

Genital segment elongate in the female, with conical lobes at the posterior corners; much shorter and without lobes in the male.

Abdomen long and narrow; anal laminae large and armed with nonplumose spines.

Maxillary hooks present; first maxillæ single; furca large and double.

First three pairs of thoracic legs biramose; endopod of first pair rudimentary; exopod of third legs divided differently from those of *Caligus* and *Lepeophtheirus*. Egg-cases like those of the Caliginæ.

Type-species.—*P. elongatus*, new species.

PARALEBION ELONGATUS,^b new species.

Female.—Carapace transversely elliptical, a little wider than long, the anterior margin slightly reentrant and without a median sinus, the posterior margin nearly straight. Posterior sinuses inclined outwards and egg-shaped; median lobe half the entire width, lateral lobes curved inward at the tips until they touch the sides of the median lobe. Grooves separating the areas arranged like the letter H as in the Caliginæ, but with certain modifications. The posterior portion

^a *Paralebion*, from παρά, near, and *Alebion*.

^b *Elongatus*, elongate.

of the H is much wider than the anterior and is transversely elliptical in form, being fully twice as wide as long. A series of grooves connect the anterior portion of the H with the lateral margin of the carapace on either side, each groove producing a slight indentation where it meets the margin. Another groove extends diagonally inward from the tip of the side of the H, the two almost meeting at the midline. This produces a configuration whose nearest approach is seen in *Caligus aliuncus* and *C. hæmulonis*.

Free thorax segment about one-fifth the width and one-fourth the length of the carapace, widened through the bases of the fourth legs, and showing there a rudimentary dorsal plate on either side, over the base of the leg. These plates are minute, but evidently correspond to the better developed ones in *Alebion* and *Gloiopotes*.

Genital segment, including the posterior lobes, as long as the carapace, but less than half as wide, with nearly straight sides and produced at each posterior corner into a conical process, three-fifths as long as the body of the segment.

Abdomen flattened cylindrical, five times as long as wide, two-jointed, with the joints about equal; anal laminae large, spatulate, each armed with four nonplumose spines. Egg-cases cylindrical, reaching just beyond the tips of the anal laminae; eggs large, about thirty in each case.

First and second antennæ like those of *Lepeophtheirus*, each of the second pair with a large spine on the posterior margin of the basal joint. Maxillary hooks long and sickle-shaped, their bases opposite the tips of the second antennæ.

First maxillæ large and undivided, each maxilla curved outward a little and reaching well beyond the tip of the mouth tube.

Furca double, the proximal end of the terminal portion telescoped inside the distal end of the basal portion, the branches strongly curved so as to make the sinus between them a half circle.

Terminal claw of the maxillipeds slender, strongly curved, and about half the length of the basal joint.

First legs with a rudimentary endopod attached to the basal segment, cylindrical in form, three-jointed, and tipped with three spines and a short rounded process. Terminal claws of the exopod diminishing a little in length from without inwards; there is no seta at the distal corner, but the three plumose setæ on the posterior margin are of the usual size.

Second legs like those of *Lepeophtheirus*; third pair with an enormous sickle-shaped claw at the base of the exopod. The groove between the two joints of this exopod, instead of being transverse as it is in *Caligus* and *Lepeophtheirus*, is fully as diagonal as it is in the fourth legs. The endopod overlaps the exopod at its base, but is considerably shorter.

Fourth legs with a stout basal joint fully as long as the three terminal joints, each of the second and third joints tipped with a short claw, the terminal joint tipped with three claws, the inner of which is three times the length of the others.

Total length, 9.4 mm. Carapace 3.2 mm. long, 3.6 mm. wide. Free segment 0.8 mm. long, 0.6 mm. wide. Genital segment 3.2 mm. long, 1.8 mm. wide. Abdomen 3.2 mm. long, 0.6 mm. wide.

Male.—Carapace and free segment like those of the female and almost exactly the same size, but the posterior body is shorter and narrower.

Genital segment spindle-shaped, only a little longer than the free segment and about the same width; abdomen one-fifth longer than the genital segment and only two-thirds as wide, two-jointed, the basal joint less than half the length of the terminal. Anal laminae fully as large as those of the female and armed with longer spines, which, however, are nonplumose.

Second antennae much inflated and covered on the ventral surface with corrugated pads, the terminal claw stout, and reinforced by several accessory claws. Basal joint of fourth legs much smaller than in the female; fifth legs not visible in dorsal view; other appendages as in the female.

Total length 6.8 mm. Carapace 3.2 mm. long, 3.4 mm. wide. Free segment 0.8 mm. long, 0.6 mm. wide. Genital segment 1.2 mm. long, 0.8 mm. wide. Abdomen 1.3 mm. long, 0.6 mm. wide. Color a light sulphur yellow, deepening into orange in the thicker portions of the carapace and the genital segment; eggs yellow.

A fine lot of specimens numbering twenty females and six males was obtained from the mouth of a shark caught in Chesapeake Bay, and belong to the museum of the Johns Hopkins University. These are cotypes of the new species, and from them two females and a male have been selected as types and deposited in the National Museum, under the Cat. No. 39553, U.S.N.M.

This new genus belongs to the Euryphorinae and is closely related to *Alebion*, but differs from it in having fully developed fourth legs, in the presence of a pair of maxillary hooks and a furca, and in the absence of the enlarged corneous claws on the first three pairs of swimming legs.

ACHTHEINUS DENTATUS,^a new species.

Female.—Carapace slightly obovate, widest anteriorly; frontal plates projecting nearly their width, but thoroughly fused with the carapace, their anterior margin evenly rounded, with a slight incision at the center. Sides of carapace and posterior margin quite convex, the latter with a deep incision on either side where the lateral area joins the thoracic. Lateral areas wide but curved over ventrally so as

^a *Dentatus*, toothed, in allusion to the teeth on the second antennae.

to appear narrow in dorsal view, and without any visible transverse groove; posterior lobes short and inclined outwards. No visible dorsal grooves on the carapace.

Second and third segments fused and covered with a single pair of elliptical dorsal plates, which are entirely distinct but overlap slightly at the center, and together are one-fourth wider than the carapace.

There is also a pair of small lateral plates covering the bases of the second legs, which are evidently the rudiments of another pair of thoracic plates, but they are concealed beneath the posterior lobes of the carapace and can not be seen except in lateral or ventral view.

Fourth segment free, with a pair of elliptical plates similar to those on the preceding segment, but a little larger. Genital segment the same width as the plates on the fourth segment, one-half wider than the carapace and evenly rounded; posterior sinus deep and triangular; posterior lobes inclined toward each other and meeting for some distance.

Abdomen attached to the ventral surface of the genital segment in front of the posterior margin, one-jointed and triangular, one-half wider than long. Anal laminae large and evenly rounded, projecting slightly beyond the posterior margin of the genital segment, each armed with four small spines. Egg strings narrow and straight, twice as long as the entire body; eggs small and numerous. Terminal joint of first antenna longer and narrower than the basal, with a tuft of setae at its tip.

Second antennae enlarged and ending in strong claws bent into a half circle, each armed with a row of stout teeth along its ventral surface near the tip. Once buried in the skin of its host, these teeth act like barbs and hold the antennae securely in place.

The mouth-tube is very pointed, with the under lip projecting some distance in front of the upper one (fig. 24); the hinge is close to the base of the tube. The mandibles are slender and reach the very end of the mouth-tube; each is armed with a dozen large teeth shaped like those on a hack saw.

Each first maxilla forms a short and stout cone, flattened side-wise, and tipped with a single small spine; on the anterior margin near the tip are three small spines close together. These maxillae stand out at right angles to the ventral surface of the head, while the mouth-tube is nearly parallel with it (fig. 24).

The second maxillae are of the usual pattern; the maxillipeds are stout and swollen and shaped much like a pair of wide boots or moccasins. The leg is the basal joint, the foot the terminal joint; from the heel projects a stout curved claw which shuts down against the sole; the latter is flat with a raised margin, and evidently acts as a suction disk to assist in attaching the parasite to its host.

All four pairs of legs are biramose; basal joints of first two pairs small, of third and fourth pairs large and laminate; rami of first three pairs two-jointed, of fourth pair one-jointed, sparingly armed with short spines without setæ.

Color a uniform cream white except in the genital segment, where the convolutions of the oviduct show an orange color; egg strings a light orange.

Total length 8.5 mm. Carapace 2.8 mm. long, 2.35 mm. wide. Dorsal thorax plates together 2.35 mm. long, 3.40 mm. wide. Genital segment 4 mm. long, 3.5 mm. wide. Egg strings 18 mm. long.

Four females belonging to this new species were obtained by Dr. R. E. Coker, for the Peruvian Government from the body and fins of a soupfin shark (*Galeus zyopterus*) near Pacasmayo, Peru, on March 12, 1907, and were sent to the author by Dr. B. W. Evermann, of the U. S. Bureau of Fisheries.

Type.—Cat. No. 39617, U.S.N.M.

These specimens were especially interesting because they served to confirm a new Pacific coast genus established by the present author in 1908.^a

This genus was founded upon a few specimens obtained from a leopard or cat shark, (*Triakis semifasciatus*), at La Jolla, California. It is closely related on the one hand to Dana's *Pholidopus* (*Lepidopus*), and on the other to Steenstrup and Lütken's *Perissopus*, but is generically distinct from both, as was clearly shown.^a The present specimens agree in every generic particular with the type species, *A. oblongus*, and thus substantiate the new genus. The teeth upon the terminal claws of the second antennæ will distinguish this species at once from *oblongus*, and, from the way in which these antennæ are carried, the teeth are very prominent and easy to observe.

LERNÆOPODA INERMIS,^b new species.

Female.—Body plump and cylindrical and bent into a crescent shape; head nearly rectangular in dorsal view, with none of the appendages except the second maxillæ visible. Both pairs of antennæ and the maxillæ are held so closely to the head that it is almost impossible to discern them from any point of view.

The first antennæ are small unsegmented papillæ, each tipped with a minute spine; the second antennæ are stout and flattened laterally into broad laminae. These antennæ are imperfectly segmented and are biramose at the tip, the dorsal ramus being a large rounded knob with a smooth surface, the ventral ramus a narrow cone made up of two joints. At the base of this cone, upon the ventral margin of the proximal portion of the appendage, is a rounded protuberance covered with short and stout spines.

^a Proc. U. S. Nat. Mus., vol. 35, 1908, p. 450.

^b *Inermis*, unarmed, in allusion to the lack of claws or spines on the maxillipeds.

The mandibles are short and stout, each bent near the center and armed at the tip with four large teeth and three small ones.

The first maxillæ are of the usual pattern; the second pair are at the extreme posterior margin of the head, are cylindrical in shape, and nearly as long as the body. The cord extending from the end of these appendages is stout, about half the diameter and one-fifth the length of the "arms" themselves, and terminates in an enormous umbrella-shaped bulla, whose diameter is considerably larger than that of the creature's body.

From the junction of the stem with the umbrella a series of ridges radiate outward toward the edge of the bulla, very similar to the ribs of an umbrella. The maxillipeds are situated a short distance in front of the second maxillæ, are stout, three-jointed, and entirely destitute of claws or armature of any sort.

The egg cases are cylindrical, as long as the thorax and nearly half as wide, and are carried turned forward against the sides of the thorax. The eggs are rather small and are arranged in twelve to fifteen longitudinal rows, about twenty-five eggs in a row.

Color, a uniform light orange yellow.

Total length 4.6 mm. Length of head 2 mm., of thorax 2.6 mm., of second maxillæ 3 mm., of egg-strings 2.6 mm. Diameter of egg strings 0.8 mm., of bulla 2.2 mm., of thorax 1.8 mm.

Three lots of this species, each consisting of a single specimen, were taken from the upper angle of the gill cavity of *Leucichthys harengus*, at the following localities: Blind River, Lake Huron; Bay Port, Michigan; Marquette, Lake Superior. One hundred and forty specimens were obtained from the same host taken in trap nets at Saginaw Bay, Lake Huron.

All of the specimens were collected by the U. S. Bureau of Fisheries through Dr. B. W. Evermann.

Type-locality.—Knife River, Duluth, Minnesota.

Type-specimen.—Cat. No. 42283, U.S.N.M.

The species is closely related to *L. extumescens* Gadd, but differs in the arrangement of the appendages, and especially in the shape of the mandibles and the teeth with which they are armed. The comparative size of the bulla is also a prominent character and perhaps the easiest one to recognize.

EXPLANATION OF THE PLATES.

PLATE 65.

Male and female of *Midias lobodes*.

- Fig. 1. Dorsal view of female.
 2. Dorsal view of male.
 3. Second antenna and maxillary hook.
 4. First maxilla of female.
 5. First maxilla of male.
 6. Furca.
 7. Second maxilla
 8. Maxilliped.
 9 to 12. First, second, third, and fourth swimming legs.

PLATE 66.

Male and female of *Paralebion elongatus*.

- Fig. 13. Dorsal view of female.
 14. Dorsal view of male.
 15. First and second antennæ, maxillary hooks, first maxillæ, and mouth-tube.
 16. Furca.
 17. Maxilliped.
 18 to 21. First, second, third, and fourth swimming legs.

PLATE 67.

Female of *Achtheinus dentatus*.

- Fig. 22. Dorsal view of female.
 23. Second antenna.
 24. Mouth-tube and first maxilla in side view.
 25. Mandible.
 26. Second maxilla.
 27. Maxilliped.
 28 to 31. First, second, third, and fourth swimming legs.
 32. Second antenna of the male of *Paralebion elongatus*.

PLATE 68.

Female of *Lernæopoda inermis*.

- Fig. 33. Side view of female.
 34. Ventral view of mouth-tube and second antenna.
 35. Mandible.
 36. Maxilliped.